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THE FIGURE OF THE EARTH.

The Earth's Axes and Triangulation. By J. de Graaff Hunter. (Survey of India Professional Paper, No. 16.) Pp. viii+219+vi charts. (Published by order of the Government of India. Dehra Dun: Printed at the Office of the Trigonometrical Survey, 1918.) Price 4 rupees or 5*s.* 4*d.*

THE Survey Department of India has long been labouring under a disadvantage which attaches to pioneers in that the fundamental constants employed as the bases of its computations, and upon the accuracy of which its final results depend, are now, and have been for a long time past, known to be in substantial error. The axes of the earth hitherto used are those derived from Everest's early work, and in view of the enormous amount of geodetic data accumulated since they were formulated, their values naturally require considerable correction in order to fit in with more recent knowledge. Furthermore, owing to the magnitude of the local attraction at Kalianpur, the point taken as the origin of the coordinates of the survey, the absolute position of this origin, and hence of every other point deduced from it, requires a further correction on this account. This correction in the case of longitudes is a constant quantity of the same magnitude at every point, and in the case of latitudes a varying quantity, depending, first, upon the absolute change in the assumed latitude of the origin, and, secondly, upon the changed distance between origin and point due to the changed spheroid.

To recompute the whole triangulation with the new origin and new axes would have been a piece of numerical work of altogether prohibitive magnitude, and the primary object of Mr. Hunter's research was to derive a formula for ascertaining the necessary corrections without repeating the whole calculation. This is not quite such an elementary problem as it appears. It might possibly be thought that it would be easy to compute the correction at a number of symmetrically situated points, say the intersections of each degree of latitude and longitude, and thence to derive the correction at any other point by interpolation. This, however, cannot be done in any simple and direct way. To derive the proper value of the correction, the "route" along which the position of the point was determined has to be considered, and if, for example, assuming the position of the origin as 0°, 0°, we thence determine the correction at the point 1°, 1°, the value will be different according as we proceed along the parallel from 0°, 0°, to 0°, 1°, and thence along the meridian to 1°, 1°, or conversely along the meridian to 1°, 0°, and thence along the parallel to 1°, 1°. This discrepancy arises from the fact that the original observations were "adjusted"—*i.e.* constrained to fit a particular spheroid—and will consequently not fit a different spheroid without distortion. There must therefore always remain a degree of uncertainty in the computed corrections, and in the final results it is claimed by Mr. Hunter, apparently with full justification, that these residual errors are of magnitudes such as to be negligible in the most precise geodetic survey.

The whole question of the adjustment of the errors of a triangulation is fully discussed, and a new method of considerable practical importance set forth. The volume embodies the results of a most laborious research, and reflects great credit upon the author and upon the Survey of India. A perusal of it brings home, however, with great force a question much to the fore lately upon which a definite solution appears at length to be in sight, viz. the imperative necessity of establishing a geodetic institute in this country. Many of the problems opened up in this volume are applicable to geodetic surveys wherever they may be undertaken, and it is scarcely an ideal state of affairs that the great responsibility for laying down new methods, and for all practical purposes deciding upon their validity, should rest on the shoulders of one survey department, often, moreover, on those of one man. These general questions should be fully investigated by all concerned who are in a position to help, and an institute which will co-ordinate the higher survey work of the whole British Empire will be in a position to assist individual survey departments in all questions of general and fundamental importance to the science of geodesy.

E. H. H.

PLANT PHYSIOLOGY.

Life Movements in Plants. By Sir J. C. Bose. (Transactions of the Bose Research Institute, Calcutta. Vol. i., parts 1 and 2, 1918.) Pp. xxiv+251+xv. (Calcutta: Bengal Government Press, 1918. Published by the Bose Research Institute, Calcutta.)

IN addition to a series of scientific papers, the volume before us contains administrative details of the Research Institute and an inaugural address delivered by Sir J. C. Bose on November 30, 1917, when the institute was opened.

India is to be congratulated upon the foundation and generous endowment of an institute of this character, which is intended to include departments for physics, plant physiology, animal physiology, and psycho-physics, as well as their applications to agriculture and medicine.

The address outlines the events leading up to the organisation of the institute. It is pointed out that the two ideals before the country are complementary and not antagonistic. "There is first the individualistic ideal of winning success in all affairs, of securing material efficiency and of satisfaction of personal ambition. These are necessary, but by themselves cannot secure the life of a nation. . . . The weakling who has refused the conflict, having acquired nothing, has nothing

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to renounce. He alone who has striven and won can enrich the world by giving away the fruits of his victorious experience. . . . The ideal of giving, of enriching—in fine, of self-renunciation in response to the highest call of humanity, is the other and complementary ideal."

The scientific papers are divided into two groups: part i., "Response in Plant Organs," and part ii., "Growth and its Responsive Variations." In many of the papers Sir J. C. Bose was assisted by his research students.

Ever since the days of his clumsy efforts to induce preparations of frogs' nerves and muscles to perform their movements with military precision, the present writer must confess to a dislike to all dealings with smoked glass plates and tracings thereupon. The records upon which the conclusions of the Calcutta laboratory are based are, however, on an entirely different level. In these, skill in manipulation and the most ingenious clockwork and electrical devices have been combined to evolve methods whereby the minute movements of response to carefully regulated stimuli have been recorded on the same chart as their time relations.

In order to cut out errors arising from the variation of factors other than the one under consideration, the observations are in most cases made only for a very short period of time. This is possible with the aid of the great magnification employed; the latter is obtained by a combination of levers coupled with the disturbance of equilibrium in a magnetic field due to the motion of the steel lever in it.

The massed attack of the workers in the Bose Institute has in a very short time cleared up much that was obscure in the phenomena of response. It may be noted, however, that the papers contain very few references to current literature, but this is perhaps owing to the novelty of the methods used. In particular, the recent work upon the transmission of a stimulus through a glass tube in the absence of all protoplasmic connection is of interest in relation to certain of the Calcutta experiments.

W. R. G. A.

ABNORMAL PSYCHOLOGY AND EDUCATION.

Echo Personalities: A Short Study of the Contributions of Abnormal Psychology towards the Solution of some of the Problems of Normal Education. By Frank Watts. Pp. 111. (London: George Allen and Unwin, Ltd., 1918.) Price 4*s.* 6*d.* net.

MANY readers of the voluminous literature upon mental and nervous disorders published almost weekly in our own country must have been struck by the vast stores of information for the educationist which these writings contain. The significance for education of much of this information lies chiefly in the fact that it tells the teacher what to avoid, but an almost equal amount is grist of the finest quality for his own particular mill; for many of the painstaking and minute analyses of these states of mental twistedness are but the prelude to a subsequent process of re-education. Here, if anywhere, may the educator of the normal child help and find help.

While, as we said, many persons must have felt all this, few have ventured upon the task so courageously undertaken by Mr. Frank Watts, that of refracting the rays of light from the dense and clouded medium of psychopathology into the somewhat clearer atmosphere of normal education. And if one feels, here and there, that an important ray fails to get through, there is little justification for grumbling at the properties of our prism, for it is almost the only one we have.

Mr. Watts has read widely; he leads us from the early giants of rational mental treatment, Pinel and Esquirol in France, and Conolly in England, to our contemporaries—whose height we cannot yet measure, perhaps because they stand too close to us—Janet of Paris, Freud of Vienna, and Jung of Zürich. In his chapter on "Psychopathology and Personality," which seems to us the best in the book, he gives clear little sketches of the typical "nervous" disorders, never forgetting that the blessed word "abnormal" does not exempt him from the obligation of showing their near relationship to "normal" eccentricities and weaknesses.

In his chapter on "The Crowd at School" he boldly acknowledges the existence of a fact—often protectively coloured, but nevertheless angular and unyielding when one strikes against it—that suggestion is the means by which most of the child's beliefs are inculcated. He draws from this the obvious conclusion that the teacher's duty is to understand the mechanism of suggestion and thereby to utilise its advantages and avoid its pitfalls. It is good to see Mr. Watts making use of that salutarily disquieting book by Mr. Trotter, "The Herd Instinct in Peace and War." But we feel that a still more extensive use of Mr. Trotter's explanation of the present unfashionableness of rational opinion and of his suggestions for making it fashionable in the future might have strengthened this chapter still more. Perhaps, however, the trouble about Mr. Trotter's "Herd Instinct" is that the title would be improved if he avoided the term "instinct" and used another word instead of "herd." Which brings up the subject of Mr. Watts's own title. On buying the book, one may understand what the title means. But is not this a reversal of the usual process?

The final chapter, on "The Psychology of the Defective Mind: its Influence upon Teaching Methods," deals in a very up-to-date way with the subject. One paragraph may be offered to the reader here as food for thought:

"One may perhaps draw attention here, in passing, to the popular modern educational ideal of self-realisation as the ultimate good. Séguin occupied himself, like Froebel and Rousseau before him, wholly with the problem of the perfecting of human personality, but a sane study of abnormal psychology should prevent us adopting the unfortunate heresy that personality is the most

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